| Notice of Allowability | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/622,976 | COLVIN ET AL. | |
| | Examiner | Art Unit | |
| | Kandasamy Thangavelu | 2123 | |

***-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--***

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *September 23, 2004*.

2. ☒ The allowed claim(s) is/are *1,5-9,11 and 15-19*.

3. ☒ The drawings filed on *18 July 2003* are accepted by the Examiner.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review ( PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   **Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date September 1, 2004
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

## DETAILED ACTION

### *Introduction*

1. This communication is in response to the Applicant's communication dated September 23, 2004. Claims 1, 2, 5, 7-9, 11, 12, 15, 17-19, 21, 22, 25, 27 and 28 were amended. Claims 30-32 were added. Claims 1-32 of the application are pending.

### *Drawings*

2. The drawings submitted on July 18, 2003 are accepted.

### *Examiner's Amendment*

3. Authorization for this examiner's amendment was given in two telephone conversations by Mr. Alton Hornsby III on July 8, 2005.

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to the applicants, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

4. In the specification, Page 4, Para 0009, Lines 4 to Page 5, Para 0009, Line 5, "plurality of values in a three-dimensional model to eliminate values which are below a threshold to create a

filtered three-dimensional model; developing a first matrix from the filtered three-dimensional model representing a two-dimensional model of the reservoir, wherein the first matrix includes a plurality of cell center locations, cell areas and a plurality of values; developing a second matrix from the first matrix using a distance-weighted sum of plurality of values; and selecting target locations from the second matrix based on the distance-weighted sum of the plurality of values",

has been changed to

- plurality of attribute values in a three-dimensional model to eliminate attribute values which are below a threshold to create a filtered three-dimensional model; developing a first matrix from the filtered three-dimensional model representing a two-dimensional model of the reservoir, wherein the first matrix includes a plurality of cell center locations, cell areas and a plurality of attribute values; developing a second matrix from the first matrix using a distance-weighted sum of plurality of attribute values; and selecting target locations from the second matrix based on the distance-weighted sum of the plurality of attribute values-.

In the specification, Page 16, Para 0048, Lines 1-3, "target and the value associated with other cells in the matrix that are within two times the user-defined radius are set to a value of zero for the selection of the next target location",

has been changed to

- target and the values associated with other cells in the matrix that are within two times the user-defined spacing radius are set to a value of zero for the selection of the next target location -.

In the specification, Page 16, Para 0049, Lines 2-3, "wherein the value of the selected target location and the values within two times the radius are set to zero",

has been changed to

- wherein the value of the selected target location and the values within two times the spacing radius are set to zero -.

In the specification, Page 17, Para 0051, Lines 2-3, "wherein the value of the selected target location and the values within two times the radius are set to zero",

has been changed to

- wherein the value of the selected target location and the values within two times the spacing radius are set to zero -.

In the specification, Page 17, Para 0052, Lines 6-9, "all possible targets have been located. The above examples use two times the radius; however, the other values of the radius may be used. The above examples use one value of interest, but the method may be extended to use more than one value to determine the target locations",

has been changed to

- all possible targets have been located. The above examples use two times the spacing radius; however, the other values of the spacing radius may be used. The above examples use one attribute value of interest, but the method may be extended to use more than one attribute value to determine the target locations-.

In the specification, Page 18, Para 0053, Lines 1-2, "matrix within two times the radius of the existing well(s) may be zeroed out before selecting the new targets",

has been changed to

- matrix within two times the spacing radius of the existing well(s) may be zeroed out before selecting the new targets -.

In the specification, Page 21, Para 0065, Lines 1-3, "associate with other cell in the matrix that are within two times the user-defined radius are set to a value of zero for the selection of the next target location (Stage 1018)",

has been changed to

- associated with other cells in the matrix that are within two times the user-defined spacing radius are set to a value of zero for the selection of the next target location (Stage 1018)-.

In the specification, Page 21, Para 0066, Lines 8-9, "value associate with other cells in the matrix that are within two times the user-defined radius are set to a value of zero",

has been changed to

- value associated with other cells in the matrix that are within two times the user-defined spacing radius are set to a value of zero -.

5. In the Claims:

In Claim 1:

Replace claim 1 with:

1. A computer-implemented method of reservoir targeting, comprising:

(a) building, from seismic data, a three dimensional model of a reservoir;

(b) triangulating the three dimensional model of the reservoir to create a schematic model comprising a three dimensional grid of cells;

(c) filtering the schematic model to eliminate cells with attribute values below a threshold and/or do not meet other predetermined selection criteria;

(d) determining a set of contiguous cells for each X and Y location (selected X and Y location ) in the schematic model, wherein the set of contiguous cells is determined by moving a window of a plurality of cells to select a window of a plurality of cells that has a maximum value of a sum of values of an attribute of interest, wherein the sum is taken over the cells in the selected window, the plurality of cells having the maximum value of the sum being the most desirable cells for the selected X and Y location;

(e) recording a center of location of the most desirable cells along with an area of the cells and the maximum value of the sum of values of the attribute of interest for the selected X and Y location in a first matrix, wherein the first matrix is a two dimensional matrix;

(f) for each cell in the first matrix, taking each cell as a selected cell, and calculating a distance weighted sum of values in the first matrix of all the cells within a multiple of a spacing radius from a center point of the selected cell, wherein a weight is selected to give more weight to cells located closer to the selected cell and less weight to cells located further from the selected cell and entering the distance weighted sum in a second matrix as an accumulated value for the selected cell;

(g) selecting the cell location having a maximum accumulated value in the second matrix as a target location;

(h) setting the value of the selected cell at the target location in the second matrix and the value of all the cells in the second matrix within a multiple of the spacing radius to zero in the first matrix;

(i) repeating steps (f) to (h) until the specified number of target locations are identified or there are no more cells with an accumulated value greater than zero.

In Claims 2-4:

Delete claims 2-4.

In Claim 5:

Replace claim 5 with:

5. The method of claim 1, wherein the accumulated value (AccumValue) associated with each center location is derived using the relationship:

AccumValue = (CumWeightedValue/CumWeight) * CumWeightedArea, wherein

CumWeightedValue = $\Sigma$ cellvalue*weight,

CumWeightedArea = $\Sigma$ cellarea* weight, and

CumWeight = $\Sigma$ (SpacingRadius - DistanceFromCell)/SpacingRadius,

where DistanceFromCell is defined as the actual distance from the cell for which the accumulated value is being calculated to a cell that is being taken into consideration and SpacingRadius is a user-defined value representing a reservoir draining radius for each target.

In Claim 7:

Replace claim 7 with:

7. The method of claim 6, wherein selecting target locations includes an iterative process of selecting the targets based on a first preferred attribute value, eliminating other targets within a predetermined distance from an initial target, and selecting a next preferred attribute value for a next target location.

In Claim 8:

Replace claim 8 with:

8. The method of claim 1, wherein selecting target locations includes an iterative process of selecting a target based on a first preferred attribute value, eliminating other targets within a predetermined distance from an initial target, and selecting a next preferred attribute value for a next target location.

In Claim 10:

Delete claim 10.

In Claim 11:

Replace claim 11with:

11. A computer-readable medium having computer-executable instructions which when executed on a computer perform a process for reservoir targeting, the process comprising:

(a) building, from seismic data, a three dimensional model of a reservoir;

(b) triangulating the three dimensional model of the reservoir to create a schematic model comprising a three dimensional grid of cells;

(c) filtering the schematic model to eliminate cells with attribute values below a threshold and/or do not meet other predetermined selection criteria;

(d) determining a set of contiguous cells for each X and Y location (selected X and Y location ) in the schematic model, wherein the set of contiguous cells is determined by moving a window of a plurality of cells to select a window of a plurality of cells that has a maximum value of a sum of values of an attribute of interest, wherein the sum is taken over the cells in the selected window, the plurality of cells having the maximum value of the sum being the most desirable cells for the selected X and Y location;

(e) recording a center of location of the most desirable cells along with an area of the cells and the maximum value of the sum of values of the attribute of interest for the selected X and Y location in a first matrix, wherein the first matrix is a two dimensional matrix;

(f) for each cell in the first matrix, taking each cell as a selected cell, and calculating a distance weighted sum of values in the first matrix of all the cells within a multiple of a spacing radius from a center point of the selected cell, wherein a weight is selected to give more weight to cells located closer to the selected cell and less weight to cells located further from the selected cell and entering the distance weighted sum in a second matrix as an accumulated value for the selected cell;

(g) selecting the cell location having a maximum accumulated value in the second matrix as a target location;

(h) setting the value of the selected cell at the target location in the second matrix and the value of all the cells in the second matrix within a multiple of the spacing radius to zero in the first matrix;

(i) repeating steps (f) to (h) until the specified number of target locations are identified or there are no more cells with an accumulated value greater than zero.

In Claims 12-14:

Delete claims 12-14.

In Claim 15:

Replace claim 15 with:

15. The computer-readable medium of claim 11, wherein developing the second accumulated value matrix further comprises deriving a accumulated value (AccumValue) associated with each center location using the relationship:

AccumValue = (CumWeightedValue/CumWeight) * CumWeightedArea, wherein

CumWeightedValue = Σ cellvalue*weight,

CumWeightedArea = Σ cellarea* weight, and

CumWeight = Σ (SpacingRadius - DistanceFromCell)/SpacingRadius,

where DistanceFromCell is defined as the actual distance from the cell for which the accumulated value is being calculated to a cell that is being taken into consideration and SpacingRadius is a user-defined value representing a reservoir draining radius for each target.

In Claim 17:

Replace claim 17 with:

17. The computer-readable medium of claim 16, wherein selecting target locations includes an iterative process of selecting the targets based on a first preferred attribute value, eliminating other targets within a predetermined distance from an initial target, and selecting a next preferred attribute value for a next target location.

In Claim 18:

Replace claim 18 with:

18. The computer-readable medium of claim 11, wherein selecting target locations includes an iterative process of selecting a target based on a preferred attribute value, eliminating other targets within a predetermined distance from a initial target, and selecting a next preferred attribute value for a next target location.

In Claims 20-32:

Delete claims 20-32.

**A clean copy of the amended claims is attached.**

## *Reasons for Allowance*

6. Claims 1, 5-9, 11, and 15-19 of the application are allowed over prior art of record.

7. The following is an Examiner's statement of reasons for the indication of allowable subject matter:

The closest prior art of record shows:

(1) a two-stage method for determining well locations in a 3-D reservoir model while satisfying constraints including minimum interwell spacing, minimum well length, distance from offshore platform etc.; the first stage solves the well spacing problem as a binary integer programming problem; the second stage considers selected vertical completions to determine well trajectories that connect the maximum reservoir proxy values; the parameters optimized are values such as porosity, net pay, permeability; the values for each volumetric cell (voxel) of the 3-D reservoir model are determined; then the reservoir quality is calculated by summing the proxy values within an estimated draining radius of the prospective well of the given voxel; the reservoir quality is calculated by first trimming the proxy measurement values below a chosen cutoff value; the range of cells that could be drained from a current cell location is determined by multiplying the draining radius by an aspect ration in each direction; in the first stage, the 3-D reservoir quality volume is used to generate a 2D quality map, by setting the quality volume for each cell to the maximum quality in the corresponding column of the cells in the 3-D volume; the binary programming formulation maximizes the overall quality of the selected well locations against the cost of drilling the wells (**Cullick et al.**, U.S. Patent 6,549,879);

(2) a neural network method for delineating hydrocarbon accumulations from seismic data; the neural network method uses a conceptual sliding window to distinguish accumulations; the sliding window distinguishes areas characteristic of hydrocarbons from areas without characteristics of hydrocarbons; the method applies the neural network to a portion of the data to create scores indicative of the presence or absence of objects within a given area; creating training sets and test sets using the data related to sub-areas which scored high and low relative to remaining sub-areas; uses the neural network and the collected seismic data to determine one or more optimal well locations (**Bush,** U. S. Patent Application 2003/0204311); and

(3) a method of three-dimensional seismic reservoir geometry characterization; the method automatically generates a finite element grid around a sloping fault; the method combines this finite element grid with the remaining finite element grid to form a hybrid grid that allows efficient solution of flow equations for the reservoir; the method triangulates the faces around the fault and assembles a hybrid grid which represents a three-dimensional model of the reservoir; (**Kocberber et al.,** U. S. Patent 5,740,342).

Additional state of the art reviewed and considered by the Examiner is found in U.S. Patent 5,757,663; U.S. Patent 6,006,832; U.S. Patent 6,315,054; U.S. Patent Application 2002/0165671; U.S. Patent Application 2003/0220739; U.S. Patent Application 2003/0043693; U.S. Patent Application 2002/0120429; U.S. Patent Application 2002/0013687; U.S. Patent Application 2002/0067373; U.S. Patent Application 2003/0023383.

None of these references taken either alone or in combination with the prior art of record disclose a computer implemented method and a computer-readable medium having computer-executable instructions for reservoir targeting, specifically including:

"determining a set of contiguous cells for each X and Y location (selected X and Y location ) in the schematic model, wherein the set of contiguous cells is determined by moving a window of a plurality of cells to select a window of a plurality of cells that has a maximum value of a sum of values of an attribute of interest, wherein the sum is taken over the cells in the selected window, the plurality of cells having the maximum value of the sum being the most desirable cells for the selected X and Y location;

recording a center of location of the most desirable cells along with an area of the cells and the maximum value of the sum of values of the attribute of interest for the selected X and Y location in a first matrix, wherein the first matrix is a two dimensional matrix;

for each cell in the first matrix, taking each cell as a selected cell, and calculating a distance weighted sum of values in the first matrix of all the cells within a multiple of a spacing radius from a center point of the selected cell, wherein a weight is selected to give more weight to cells located closer to the selected cell and less weight to cells located further from the selected cell and entering the distance weighted sum in a second matrix as an accumulated value for the selected cell".

8. Any comments considered necessary by applicants must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue

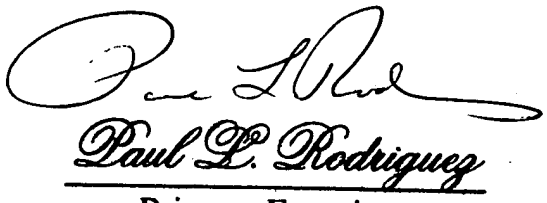
fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Kandasamy Thangavelu whose telephone number is 571-272-3717. The examiner can normally be reached on Monday through Friday from 8:00 AM to 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Leo Picard, can be reached on 571-272-3749. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to TC 2100 Group receptionist: 571-272-2100.

K. Thangavelu
Art Unit 2123
July 8, 2005



7/11/05

Paul L. Rodriguez
Primary Examiner
Art Unit 2125